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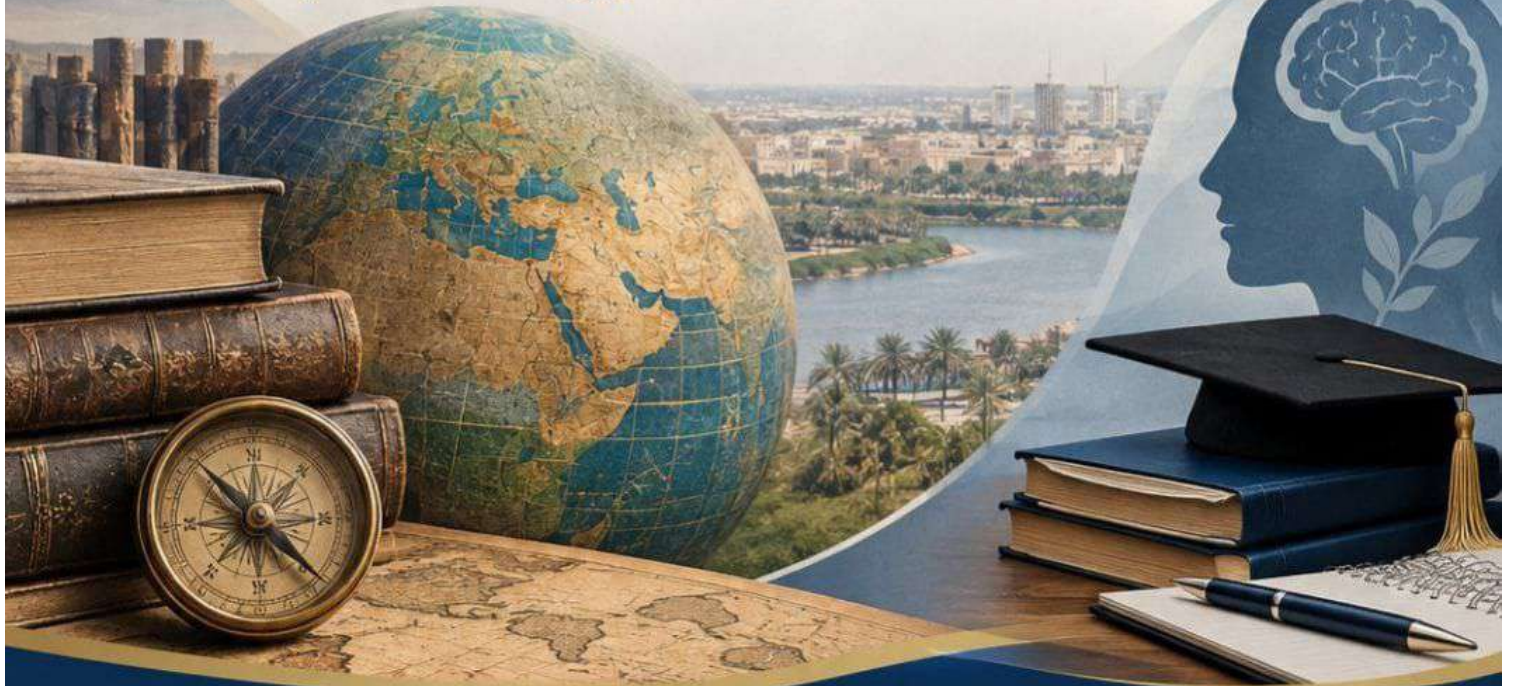
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بسم الله الرحمن الرحيم

افتتاحية العدد

الحمد لله رب العالمين، والصلاة والسلام على خاتم الأنبياء والمرسلين، سيدنا محمد، وعلى آله وصحبه أجمعين.

أما بعد...

يسرنا أن نضع بين أيديكم العدد الثالث لعام ٢٠٢٦ من مجلة جامعة الأنبار للعلوم الإنسانية، وهي مجلة علمية فصلية محكمة تصدر عن جامعة الأنبار، وتُعنى بنشر البحوث والدراسات العلمية الرصينة في مختلف التخصصات التي تندرج ضمن نطاقها العلمي والمعرفي. ويضم هذا العدد أربعة عشر بحثاً علمياً لباحثين من داخل العراق وخارجه، ومن جامعات ومؤسسات أكاديمية متعددة، بما يعكس تنوعاً علمياً يسهم في إثراء المعرفة الإنسانية وتوسيع آفاق البحث العلمي. ويجسد ما يتضمنه هذا العدد من بحوث جهداً علمياً متميزاً، ثمرةً لجهود الباحثين وإسهاماتهم العلمية والفكرية، فضلاً عن الجهود التي بذلتها هيئة التحرير والمحكمون من الأساتذة المتخصصين، الذين أسهموا بخبراتهم العلمية في تقويم البحوث ومراجعتها وفق المعايير الأكاديمية المعتمدة، وصولاً إلى إخراجها بالصورة العلمية التي تليق بمكانة المجلة ورسالتها. وإذ تفخر هيئة التحرير بما تضمنه هذا العدد من دراسات وبحوث، فإنها تتقدم بخالص الشكر والتقدير إلى جميع الباحثين والمحكمين، وإلى كل من أسهم في إنجاز هذا العدد وإخراجه، سائلين الله تعالى أن يجعل هذا النتاج العلمي نافعاً للباحثين وطلبة الدراسات العليا والمهتمين، وأن يمثل إضافةً نوعية إلى المكتبة العلمية في مجال العلوم الإنسانية. إن ما تشهده المجلة من عطاء علمي متواصل من الباحثين، وجهود متنامية من رئيس وأعضاء هيئة التحرير، إلى جانب الدعم المتواصل من رئاسة جامعة الأنبار وعمادة كلية التربية للعلوم الإنسانية، يشكل ركيزة أساسية لمواصلة مسيرة التطوير والارتقاء بالمجلة وتحقيق أهدافها العلمية والأكاديمية.

وانطلاقاً من حرصنا على تعزيز حضور المجلة في الأوساط الأكاديمية، فإن هيئة التحرير تعمل بصورة مستمرة على تطوير معايير النشر وتحديث آلياته وإجراءات التحكيم والتحرير، بما ينسجم مع المعايير المعتمدة في النشر العلمي الرصين، ويعزز جودة البحوث المنشورة ويرتقي بمستوى الأعداد المقبلة. ونطمح، من خلال هذه الجهود، إلى الوصول بالمجلة إلى مكانة علمية متقدمة، وتعزيز فرص إدراجها ضمن المستوعبات وقواعد البيانات العالمية المعنية بالنشر العلمي، بما يرسخ حضورها في المشهد الأكاديمي العربي والدولي.

كما نؤمن بأن المجالات العلمية المحكمة تمثل إحدى الركائز الأساسية في منظومة البحث العلمي، لما تؤديه من دور في إنتاج المعرفة وتداولها، وإتاحة نتائج البحوث أمام الباحثين والمهتمين، وإسهام في بناء جسور التواصل العلمي بين الجامعات والمؤسسات الأكاديمية داخل العراق وخارجه. ومن هذا المنطلق، تسعى المجلة إلى أن تكون منبراً علمياً فاعلاً يواكب التطورات المعاصرة في مجالات العلوم الإنسانية، ويشجع على البحث العلمي الرصين، ويفتح المجال أمام الدراسات الجادة التي تسهم في فهم القضايا الإنسانية والفكرية والاجتماعية والثقافية.

وفي الختام، نتقدم بالشكر والتقدير إلى جميع الباحثين الذين أسهموا في هذا العدد، وإلى السادة المحكمين وأعضاء هيئة التحرير، وإلى رئاسة جامعة الأنبار وعمادة كلية التربية للعلوم الإنسانية على دعمهم المستمر لمسيرة المجلة. ونأمل أن يلقي هذا العدد ما يستحقه من اهتمام الباحثين والقراء، وأن يواصل إسهامه في خدمة المعرفة والبحث العلمي.

والله وليّ التوفيق.

أ.د. فؤاد محمد فريح

رئيس هيئة التحرير

تعليمات النشر في مجلة جامعة الأنبار للعلوم الإنسانية

الاجراءات والمواصفات العامة للبحث:

- مجلة جامعة الانبار للعلوم الانسانية, مجلة علمية دورية محكمة, لنشر الأبحاث العلمية في مجال العلوم الانسانية الاتية: التاريخ, والجغرافيا, والعلوم التربوية والنفسية وتصدر بواقع ٤ اعداد سنوياً.
- يقدم الباحث على الموقع الالكتروني للمجلة <https://juah.uoanbar.edu.iq> وفق المواصفات الاتية: حجم الورق 4 A, وبمسافتين بما في ذلك الحواشي الهوامش والمراجع والجداول والملاحق, وبحواشي واسعة ٢,٥ سم او اكثر اعلى واسفل وعلى جانبي الصفحة .
- يقدم الباحث خطاباً مرافقاً يفيد ان البحث او ما يشابهه لم يسبق نشره, ولم يقدم لأي جهة اخرى داخل العراق او خارجه, ولحين انتهاء اجراءات البحث.
- يكون الحد الاقصى لعدد صفحات البحث ٢٥ صفحة.
- يكون البحث مكتوباً بلغة سليمة باللغة العربية او اللغة الانكليزية ومطبوع على الالة الحاسبة بخط Simplified Arabic حجم ١٤, على ان يتم تمييز العناوين الرئيسة والفرعية.
- تكتب الهوامش والمراجع وفق نظام APA للتوثيق, بخط حجم ١٤, على ان يتم ترتيبها بالتتابع كما وردت في المتن, ويكون تنظيم المراجع هجائياً حسب المنهجية العلمية المعتمدة وباللغتين العربية والانكليزية.
- تؤول كافة حقوق النشر الى المجلة.
- تعبر البحوث عن اراء مؤلفيها, ولا تعبر بالضرورة عن رأي المجلة.

بيانات الباحث والملخص:

- يلزم الباحث بتقديم البيانات الخاصة به وببحثه, وباللغتين العربية والانكليزية, وتشمل الاتي: عنوان البحث, أسماء وعناوين الباحثين, ورقم الهاتف النقال, والبريد الالكتروني, وملخصين - عربي وانكليزي - بحد ادنى ٢٥٠ كلمة يحتويان الكلمات المفتاحية للبحث, والهدف من البحث, والمنهج المتبع بالبحث, وفحوى النتائج التي توصل اليها.

ادوات البحث والجداول:

- اذا استخدم الباحث استبانة او غيرها من ادوات جمع المعلومات, فعلى الباحث ان يقدم نسخة كاملة من تلك الاداة, ان لم يكن قد تم ورودها في صلب البحث او ملاحقه.
- اذا تضمن البحث جداول او اشكال يفضل ان لا يزيد عرضها عن حجم الصفحة 4 A, على ان تطبع ضمن المتن.
- يوضع الشكل بعد الفقرة التي يشار اليه فيها مباشرة, ويكون عنوانه في اسفله.
- يوضع الجدول بعد الفقرة التي يشار اليه فيها مباشرة, ويكون عنوانه في اعلاه.

تقويم البحوث:

- تخضع جميع البحوث المرسله الى المجلة الى فحص اولي من قبل هيئة التحرير لتقرير اهليتها للتحكيم, ويحق لها ان تعتذر عن قبول البحث دون بيان الاسباب.
- جميع عمليات تقويم البحوث الى نظام التعمية المزدوجة لضمان رصانة البحوث والابتعاد عن تضارب المصالح.
- تخضع جميع البحوث للتقويم العلمي بما يضمن رصانتها العلمية, وقد يطلب من الباحث اذا اقتضى الامر مراجعة بحثه لإجراء تعديلات عليه.

الوصول المفتوح:

- متاحة جميع البحوث على موقع المجلة الالكتروني وموقع المجلات الاكاديمية العراقية ضمن سياسة الوصول المفتوح.



اجور النشر:

يقوم الباحث بتسديد اجور النشر, والبالغة ١٥٠,٠٠٠ مائة وخمسة وعشرون الف دينار عراقي للبحوث باللغة العربية, و٧٥.٠٠٠ خمسة وسبعون الف دينار للبحوث باللغة الانكليزية, واذا زادت صفحات البحث عن ٢٥ صفحة تضاف ٥,٠٠٠ خمسة الاف دينار عراقي عن كل صفحة.

الباحثون من خارج العراق تنشر نتائجهم العلمية مجانا.

المراسلات:

توجه المراسلات الى: جمهورية العراق – جامعة الأنبار – كلية التربية للعلوم الانسانية- مجلة جامعة الأنبار للعلوم الإنسانية

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Geomorphological Characteristics of the Wadi Majer Basin, Zliten, Libya, and Their Relationship to Groundwater-Level Rise Using GIS and Remote Sensing

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A B S T R A C T

Aims: This study aims to investigate the natural characteristics of the Wadi Majer Basin in the Zliten area of Libya and to analyze them using geospatial techniques, given the importance of such approaches in the study of drainage basins, particularly those located in arid environments characterized by considerable topographic and hydrological variability. The study further seeks to characterize the spatial attributes of the basin, including elevation, slope, and terrain levels, and to examine their relationship with the spatial distribution and rising levels of groundwater. Particular attention is given to the relationship between the basin's natural characteristics and the occurrence of groundwater seepage and flooding, as well as to identifying the areas most affected by this phenomenon and the spatial factors contributing to its occurrence. The study also aims to employ the results of geospatial analysis to explain the spatial variability of groundwater levels and identify areas where topographic characteristics coincide with high densities of lineaments. **Methodology:** The study employed a combination of analytical and interpretive approaches appropriate to its objectives, together with geospatial techniques for analyzing the natural and hydrological characteristics of the Wadi Majer Basin. A range of spatial variables—including elevation, slope, terrain levels, and lineaments—were analyzed to examine their spatial distribution and relationship to rising groundwater levels. The Wadi Majer Basin covers approximately 1,056.4 km², representing about 39% of the total area of Zliten, while the affected area investigated in the study covers approximately 21.1 km². Groundwater levels in wells were also monitored, and temporal changes during the study period were

analyzed to determine the magnitude and spatial and temporal variability of groundwater-level rise. In addition, spatial correspondence between low-lying areas and lineament density was examined to assess the extent to which these characteristics are associated with the occurrence of groundwater seepage and flooding. **Results:** The findings revealed a clear spatial relationship between certain natural characteristics of the basin and elevated groundwater levels. Low-lying areas were identified as the locations most susceptible to water accumulation and the emergence of groundwater seepage and flooding. Monitoring of well water levels indicated a rise of approximately 15 cm, particularly during January, reflecting temporal variability in groundwater levels across the study area. Spatial analysis also revealed a correspondence between low-lying areas, areas of high lineament density, and the locations affected by groundwater seepage and flooding. A total of eight lineaments were identified. This spatial correspondence highlights the importance of topographic and structural characteristics in explaining the spatial distribution and elevation of groundwater levels, as well as in delineating areas affected by groundwater seepage and flooding. The results further demonstrate the effectiveness of geospatial techniques in clearly revealing the spatial relationships among surface characteristics, lineaments, and groundwater levels. **Conclusions:** The study concludes that geospatial techniques provide an effective framework for investigating the natural characteristics of drainage basins and analyzing spatial relationships associated with groundwater, particularly in arid environments. The findings confirm that elevation, slope, terrain levels, and lineaments are important factors in explaining the spatial variability of groundwater levels within the Wadi Majer Basin. Low-lying areas were found to be closely associated with elevated groundwater levels and groundwater seepage and flooding, while the presence and density of lineaments contribute to explaining this spatial pattern, as demonstrated by the correspondence between low-lying areas, the density of the eight identified lineaments, and the locations of groundwater seepage and flooding. Monitoring of well water levels also recorded a rise of up to 15 cm, particularly in January, confirming temporal fluctuations in groundwater levels. Accordingly, the findings of geospatial analysis can be utilized to identify areas vulnerable to groundwater-level rise and to support planning and mitigation efforts aimed at reducing the impacts of groundwater seepage and flooding in the Zliten area.

Keywords: Groundwater Overflow, RS-GIS DEM, Wadi Majer.

الخصائص الجيومورفولوجية لحوض وادي ماجر، زليتن – ليبيا وعلاقتها بارتفاع منسوب المياه الجوفية باستخدام نظم المعلومات الجغرافية وتقنيات الاستشعار عن بعد (RS_GIS)

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الملخص:

الأهداف: يهدف البحث الحالي إلى الكشف عن الخصائص الطبيعية لحوض وادي ماجر في منطقة زليتن بليبيا، وتحليلها باستخدام التقنيات الجيومكانية، لما لهذه التقنيات من أهمية في دراسة الأحواض المائية، ولا سيما الأحواض الواقعة ضمن البيئات الجافة التي تتسم بتباين خصائصها التضاريسية والهيدرولوجية. كما يسعى البحث إلى تحديد الخصائص المكانية للحوض، بما في ذلك الارتفاعات والانحدارات والمناسيب، وتحليل مدى ارتباطها بتوزيع المياه الجوفية وارتفاع مناسيبها. ويركز البحث بصورة خاصة على دراسة العلاقة بين الخصائص الطبيعية للحوض وظهور حالات طفح المياه الجوفية، فضلاً عن تحديد المناطق الأكثر تأثراً بهذه الظاهرة والكشف عن العوامل المكانية التي تسهم في حدوثها. كما يهدف إلى توظيف نتائج التحليل الجيومكاني في تفسير التباين المكاني لمناسيب المياه الجوفية وتحديد المناطق التي تتقاطع فيها الخصائص التضاريسية مع كثافة التراكيب الخطية. **المنهجية:** اعتمد البحث على مجموعة من المناهج التحليلية والتفسيرية الملائمة لطبيعة الدراسة، مع توظيف التقنيات الجيومكانية في تحليل الخصائص الطبيعية والهيدرولوجية لحوض وادي ماجر. وتم تحليل مجموعة من المتغيرات المكانية، من أبرزها الارتفاعات والانحدارات والمناسيب والتراكيب الخطية، بهدف الكشف عن طبيعة توزيعها وعلاقتها بارتفاع مناسيب المياه الجوفية. تبلغ مساحة حوض وادي ماجر نحو 1056.4 كم²، وهي تمثل ما يقارب 39% من المساحة الكلية لمنطقة زليتن، في حين بلغت مساحة المنطقة المتضررة المدروسة نحو 21.1 كم². كما تم الاعتماد على مراقبة مناسيب الآبار وتحليل التغيرات التي طرأت عليها خلال فترة الدراسة، بهدف تحديد مقدار ارتفاع المياه الجوفية وتباينها الزمني والمكاني. وتم كذلك تحليل التوافق المكاني بين المناطق المنخفضة وكثافة التراكيب الخطية، للكشف عن مدى ارتباط هذه الخصائص بظاهرة طفح المياه الجوفية. **النتائج:** أظهرت نتائج التحليل وجود علاقة مكانية واضحة بين بعض الخصائص الطبيعية للحوض وارتفاع مناسيب المياه الجوفية، إذ تبين أن المناطق المنخفضة تمثل أكثر المواقع قابلية لتجمع المياه وظهور آثار الطفح الجوفي. كما أظهرت مراقبة مناسيب الآبار حدوث ارتفاع في مستوى المياه الجوفية بلغ نحو 15 سم، ولا سيما خلال شهر يناير، الأمر الذي يعكس وجود تباين زمني في مناسيب المياه داخل منطقة الدراسة.

وبينت نتائج التحليل المكاني وجود تطابق بين المناطق المنخفضة وكثافة التراكيب الخطية، التي بلغ عددها 8 تراكيب خطية، وبين مواقع طفح المياه الجوفية. ويشير هذا التطابق إلى أهمية الخصائص التضاريسية والبنوية في تفسير التوزيع المكاني للمياه الجوفية وارتفاع مناسيبها، فضلاً عن دورها في تحديد المناطق المتضررة من ظاهرة الطفح. كما أثبتت التقنيات الجيومكانية قدرتها على إظهار العلاقات المكانية بين عناصر السطح والتراكيب الخطية ومناسيب المياه الجوفية بصورة أكثر وضوحاً. الاستنتاجات: خلص البحث إلى أن التقنيات الجيومكانية تمثل أداة فعالة في دراسة الخصائص الطبيعية للأحواض المائية وتحليل العلاقات المكانية المرتبطة بالمياه الجوفية، ولا سيما في البيئات الجافة. وأكدت النتائج أن الارتفاع والانحدار والمناسيب والتراكيب الخطية تعد من العوامل المهمة في تفسير التباين المكاني لمناسيب المياه الجوفية في حوض وادي ماجر. كما تبين أن المناطق المنخفضة ترتبط بصورة واضحة بمواقع ارتفاع المياه الجوفية وطفحها، وأن وجود التراكيب الخطية يسهم في تفسير هذا التوزيع المكاني، بدليل التطابق بين المناطق المنخفضة وكثافة التراكيب الخطية البالغة ثمانية تراكيب ومواقع الطفح الجوفي. كذلك أظهرت متابعة مناسيب الآبار ارتفاعاً وصل إلى 15 سم، خاصة في شهر يناير، مما يؤكد وجود تغيرات زمنية في مستوى المياه الجوفية. وبناءً على ذلك، يمكن الاستفادة من نتائج التحليل الجيومكاني في تحديد المناطق المعرضة لارتفاع المياه الجوفية، ودعم عمليات التخطيط والمعالجة والحد من الآثار المترتبة على ظاهرة الطفح الجوفي في منطقة زليتن.

الكلمات المفتاحية: طفوح المياه الجوفية، RS-GIS DEM، وادي ماجر.

Introduction:

The natural characteristics of the Wadi Majer basin in the Zliten region are diverse in terms of elevations, slopes, and geological features, including linear structures and directions. The basin covers an area of 1,171.9 km², accounting for approximately 38% of the total area of Zliten. The regions that have experienced groundwater overflow are part of the Wadi Majer basin, specifically the areas of (Al-Nashiya, Al-Mantriha, Al-Baza, and Rumayah), which collectively cover an area of 21 km². Utilizing GIS-RS technologies to identify the physical characteristics of the basin is of considerable importance. Since the second half of the twentieth century, GIS-RS technologies have been increasingly integrated into numerous natural studies in developed countries, witnessing significant advancement in the past two decades (Anwar et al , 2024). These technologies have provided substantial capabilities in topographical studies, especially in the analysis and interpretation of basin features.

Examining the natural attributes of the basin represents one of the most effective



methods for understanding and addressing various issues, such as explaining the phenomenon of groundwater overflow in the region. The models employed in these technologies serve to simplify a complex reality; each model has a representational role grounded in mathematical language, and model construction is a means of discovery rather than a direct representation of reality—it is, rather, a creation of it (Hamdan et al., 2025).

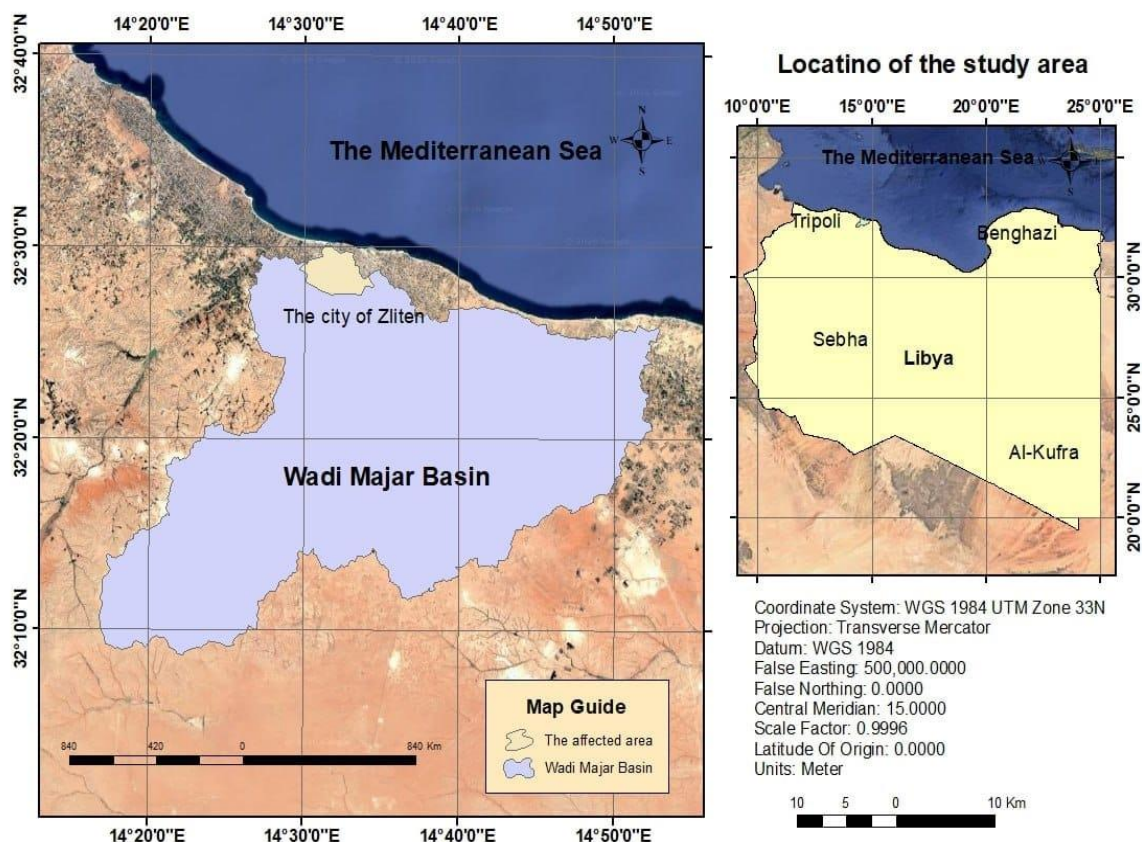
The study problem was is Groundwater in the city of Zliten, Libya, is considered a major challenge affecting the environment and public health—particularly since 2020, when residents began noticing a rise in contaminated groundwater levels—and the problem has continued to worsen to this day.

The present study aims to employ GIS-RS techniques in examining the natural characteristics of the Wadi Majer basin in the Zliten region and their relation to groundwater overflow. In other words, it seeks to determine the extent to which geographical factors influence the distribution of groundwater, by analyzing spatially-referenced data—i.e., the automated measurement of the basin's natural features to better understand this phenomenon.

Geographical Location:

The study area encompasses the Wadi Majer basin, situated within the administrative boundaries of the Zliten region. The basin is located between latitudes 32°09' and 32°30' North, and longitudes 14°18' and 14°53' East. The affected area, which have witnessed groundwater overflow, are situated in the northwestern part of the basin (see Map 1).

Map 1: Location of the Study Area



Source: Prepared by the researchers based on the Digital Elevation Model (DEM) using ARC GIS 10.3 software.

Research Problem:

This study seeks to answer the following questions:

1. Is there a relationship between the natural characteristics of the Wadi Majer basin and the occurrence of groundwater seepage in the specified areas?
2. Are GIS-RS technologies effective in analyzing the natural features of the Wadi Majer basin?
3. What are the distinctive landforms that characterize the Wadi Majer basin?

Significance of the Study:

This study derives its significance from its aim to analyze the relationship between geomorphological characteristics and the phenomenon of rising groundwater levels in the Wadi Majar basin in the city of Zliten, utilizing Geographic Information System (GIS) and remote sensing techniques. It also contributes to identifying the natural factors influencing groundwater distribution and mapping areas most

susceptible to rising water levels; this supports urban planning and sustainable water resource management, while helping to mitigate the environmental and economic impacts of this phenomenon, particularly in urban and agricultural areas..

Terminology:

1. **Topographic Profile:** A graphical line that represents the general shape and elevation of the earth's surface along a given line, which may be straight and positioned horizontally, vertically, or obliquely on the map (Al-Rikabi ,2017).
2. **Modeling:** A means of understanding processes occurring on the earth's surface; spatial relationships can be interpreted, processed, and simulated through models (Jawdah,— et al. 1991).
3. **DEM (Digital Elevation Model):** A digital representation and simulation of the earth's surface elevations.
4. **Remote Sensing:** The science of obtaining various types of information about a phenomenon or region through the analysis of data acquired by a sensor device that does not physically touch the area or object (Al-Taie, 2013, p. 175).
5. **Geomatics:** A term derived from “geo-” meaning geography, and “matics” from informatics; it refers to the use of a suite of computer-based technologies and software to collect, analyze, store, and display quantitative and qualitative data (Al-Dulaimi & Al-Jabri, 2018, p. 11)

Geological Structure:

Studying the geological structure of the basin aids in understanding many aspects of the basin's topographical evolution. The pattern of basin drainage varies depending on the type and nature of the rocks, and the basin's area is connected to its geological formations. Basin area increases in softer, less resistant regions that are more susceptible to water erosion or where tectonic activity has caused subsidence in the base levels (Mustafa, 1989, p. 170). The geological structure of the region—like other areas in North Africa—has, over its long geological history, been affected by tectonic movements and climatic changes. These processes have been accompanied by marine incursions, particularly during the Tertiary and Quaternary periods, during which the sea's influence gradually diminished. The area also experienced subsidence, leading to its inundation by the sea, but with the onset of the

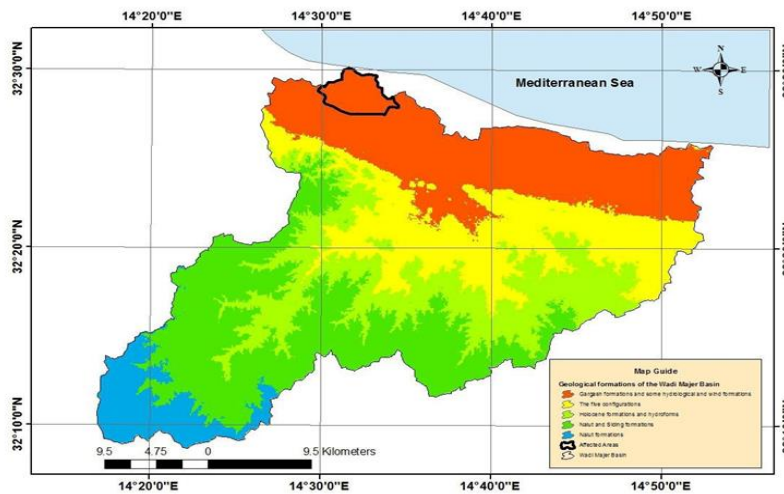
Pleistocene, most of the layers exposed at the surface became dry land. Returning to the Pleistocene and Holocene epochs (Industrial Research Center (Rashed & Farag, 2016).the region consisted of modern layers and deposits. The geological sequence of the area is also related to geological events that took place in northern Libya, particularly in the northwest. As this area is part of northwest Libya, its impact is naturally reflected in the geomorphological features of the region (George , et al 2023).

Geological Formations:

The purpose of studying these formations is to understand the nature and characteristics of the strata and their relationship to groundwater recharge. The geological structures of the study area are generally uncomplicated, dominated by Quaternary geological formations that are exposed at the surface in most of the area, and whose tectonic system is considered fundamental. In addition, varying climatic conditions at different times have contributed to the emergence of the region's geomorphological features. The geological map of the basin reveals that it encompasses several geological formations, created during different periods. The oldest date back to the Cretaceous period (Second Era), appearing as multiple layers in most parts of the basin. The Tertiary period is represented by the Khoms Formation, while the Quaternary covers various sections of the basin with diverse formations (Industrial Research Center Handbook, 1979, p. 9). Based on the geological map, the geological formations of the various layers within the basin can be classified from oldest to youngest as follows:

Formations of the Cretaceous (Second Era):

These are represented by the Nalut Formation and the Sidi El-Sid Formation, the latter of which overlies other formations in different parts of the basin, although it does not always precisely correspond to the Sid Formation. The distinction between them is very clear, as the Nalut Formation consists mainly of dolomite with chert intercalations, separating it from the Sid Formation, which includes marl limestone and is located beneath the Nalut Formation. This is the oldest formation in the area (Industrial Research Center Handbook, 1979, p. 9), consisting of highly permeable dolomitic limestone with quartz interbeds. These two formations are present in the central, eastern, and western parts of the Wadi Majer basin, while the less mixed Nalut Formation is found in the southern part of the basin (see Map 2).

Map 2: Geological Formations of the Basin

Geological Map of Libya, Al-Khums Geological Sheet No. (SH 33-14), Industrial Research Centre, First Edition (1975); ArcGIS 10.3 software.

Tertiary Formations:

These formations are restricted to Miocene rocks, with the most prominent being clay, limestone, marl, and calcarenite. Locally, these formations are known as the Khoms Formation and are widespread throughout the area. Fossil deposits found within this formation indicate that the region's topography was shaped by erosional processes, resulting in the emergence of uplands and lowlands during the Miocene stage (Al-Ghafoud, 2023, p. 24). The Khoms Formation appears in some central parts of the basin, as is the case in several other basins, as well as in the eastern and western sections (see Map 2).

Quaternary Formations:

These formations cover vast areas within the basins of the study area and can be classified as follows:

Pleistocene Formations:

The Qargash Formation in the study area dates to the glacial period and consists of beach sands intermixed with clay. These sandy deposits intermittently contain granular crystals with small amounts of calcium carbonate, contributing to their cohesion. This formation is especially notable in the northern part of the basin, prevailing in the affected regions (Al-Nashiya, Al-Mantriha, Al-Baza, and Rumayah), which have experienced rises in groundwater levels.

Recent Holocene Formations:

These are among the most widely distributed deposits in the study area and comprise different sections, each formed under specific conditions:

- **Wadi (Valley) Deposits:**

These deposits are found along the courses of wadis and are primarily composed of unconsolidated sand with some gravel, deposited by successive flood events and continuing to accumulate to the present day. They also contain varying amounts of calcium carbonate and gypsum. These deposits are observable along all the wadi channels in the study area.

- **Fluvio-aeolian Deposits:**

These consist of fine sand, gravel, and silt transported by flowing water or floods in the modern era. Their formation is attributed to the re-deposition of material eroded from various rocks by wind and water from elevated areas. They are evident in some parts of the affected area and can be seen in the central sections of the Wadi Majer basin.

1. General Characteristics of the Basin's Nature

Most parts of the basin are characterized by limited ruggedness and gentle slopes, owing to the scarcity of major elevations and the low variation in elevation across the basins. The basin's surface topography is shaped by the interaction of multiple factors, chiefly geological and climatic characteristics. Studying water basins is crucial for uncovering the causes of rising groundwater levels, in addition to hydrological indicators such as flow direction (Nazeer, M., et al .2025). The principal general features of the basin's topography can be summarized as follows:

Elevations:

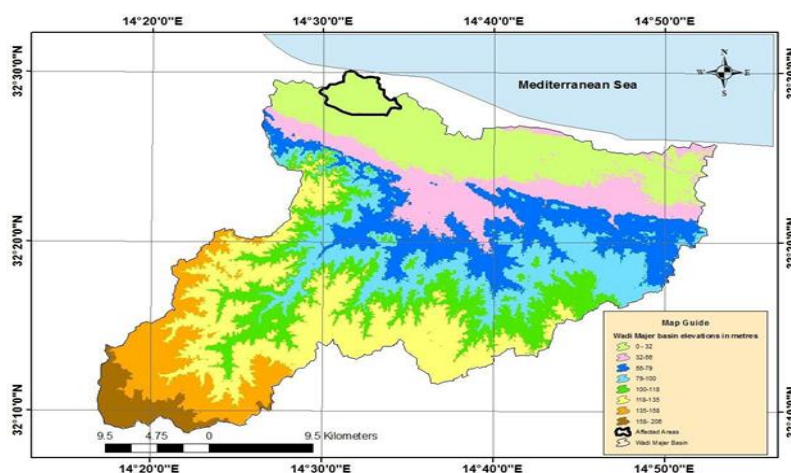
The elevations within the study basin vary from place to place, ranging between 0 and 206 meters above sea level. Wadi Majer is one of the largest basins in the area. According to Map (3) and Table (1), the basin's surface elevations range from 0 to 206 meters above sea level, with an overall average of 89.43 meters. The basin gradually declines toward its outlet at the sea, with the lowest point at Al-Baza, near the desalination plant (0 meters). The following map shows the clear diversity in surface elevations within the basin, which has been divided into eight elevation classes, summarized as follows:

- **Class I:** Elevations range from 0 to 32 meters above sea level, covering an area of 164.64

km² (15.59% of the total basin area). These areas have very gentle slopes and extend widely in the northern part of the basin overlooking the sea. The regions experiencing groundwater rise (Al-Nashiya, Al-Mantriha, Al-Baza, and Rumayah) fall within this class, with elevations not exceeding 14 meters—the lowest in the basin—making these areas most prone to groundwater rise, while the higher, faster-draining classes are less susceptible due to their elevation and low infiltration.

- **Class II:** Elevations range from 32 to 56 meters, covering 103.93 km² (10.5% of the basin), extending in some coastal areas but mostly lying south of Class I in the basin's north.
- **Class III:** Elevations range from 56 to 79 meters, with an area of 136.61 km² (12.93% of the basin).
- **Class IV:** Elevations range from 79 to 100 meters, comprising 152.25 km² (14.41% of the basin). This is the fourth largest category by both rank and area.
- **Class V:** Elevations range from 100 to 118 meters, covering 164.12 km² (15.54% of the basin).
- **Class VI:** Elevations range from 118 to 135 meters, covering 200.20 km² (18.96% of the basin), the largest class by area. This class is found in some southern sections, parts of the central eastern valley, and some western areas.
- **Class VII:** Elevations range from 135 to 158 meters, with an area of 92.02 km² (8.71% of the basin), present in the southern, eastern, and western parts of the basin.
- **Class VIII:** Elevations range from 158 to 206 meters, covering 35.12 km² (3.82% of the basin), found exclusively in the southern sections.

Map (3): Elevation Classes of the Basin



Source: Created by the researchers based on the Digital Elevation Model (DEM) using ARC GIS 10.3.

Table (1): Elevation Classes of the Lower Wadi Majer Basin

T	Height categories in meters	Area km2	percentage%
1	0-32	164.64	15.59
2	32-56	110.34	10.50
3	56-79	136.61	12.93
4	79-100	152.25	14.45
5	100-118	164.12	15.54
6	118-135	200.20	18.96
7	135-158	92.02	8.71
8	158-206	35.12	3.32
Average height		1056.4	100%

Source: Created by the researchers based on the Digital Elevation Model (DEM) using ARC GIS 10.3.

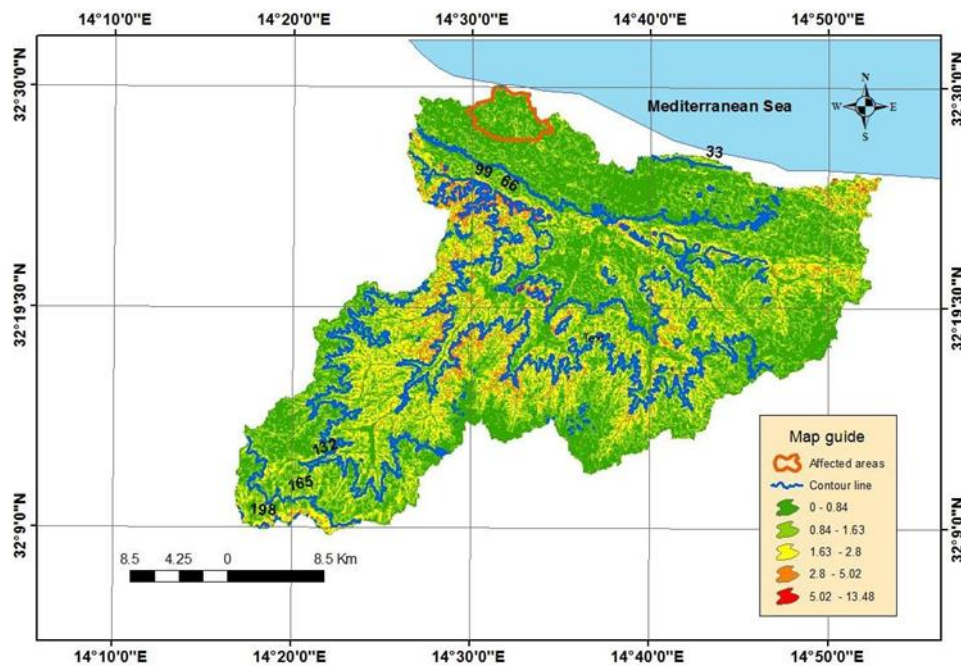
Analysis of Slope Characteristics

Slope is one of the natural features that demonstrates an inverse relationship between infiltration and land inclination. It is a key metric that provides a comprehensive understanding of the region's surface variability. To facilitate the identification of slope degrees and topographic features, contour lines were integrated with slope maps to delineate the shapes of basin surfaces, the configuration of slopes, and river drainage patterns, thus representing both the vertical and horizontal dimensions using contour elevation values as follows:

The lowest slope in the basin was 0 degrees, while the highest recorded slope was 13.49 degrees, with an overall average of 1.27 degrees. As shown in Table (2) and Map (4), gentle and nearly level slopes account for 90% of the basin's area, including zones with high groundwater levels. This indicates weak surface runoff in these areas, making them particularly favorable for rising groundwater due to their flatness. The remaining area is characterized by moderate to above-moderate slopes according to Young's classification. Contour lines range between 33 and 198 meters above sea level, with some intervals of close

proximity observed between them.

Map (4): Slope Degrees in the Wadi Majer Basin



Source: Prepared by the researchers based on the Digital Elevation Model (DEM) and using ARC GIS 10.3.

Table (2): Slope Degrees of the Wadi Majer Basin

T	Regression categories	Area km2	Percentage%	Description of the slope
1	0- 0.84	408.85	38.78	almost flat slope
2	- 1.64	359.82	36.01	almost flat slope
3	- 2.8	217.85	19.63	gentle slope
4	- 5.02	60.86	4.76	gentle slope
5	- 13.49	8.66	0.82	above average slope
Average slope		1056.4	100%	Average of slop 1.27

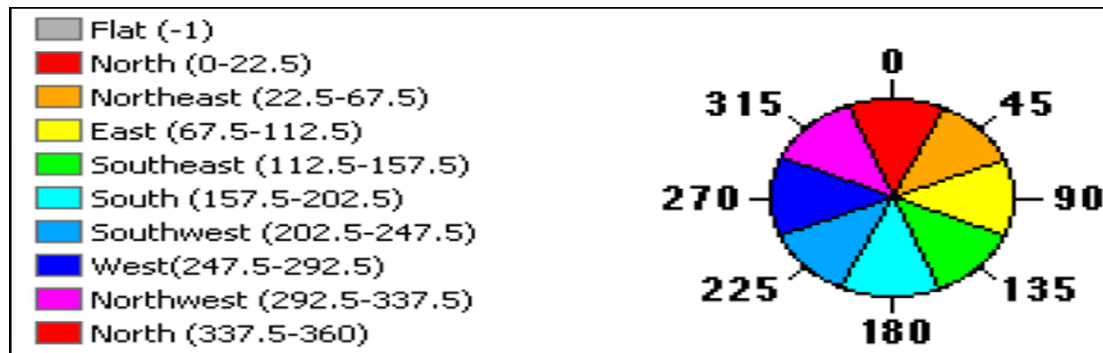
Source: Prepared by the researchers based on the Digital Elevation Model (DEM) and using ARC GIS 10.3.

Slope Aspect:

This refers to the direction toward which the slope faces, whether toward primary or secondary compass points (e.g., north, south, northwest, southeast, etc.). The aspect indicates the steepest direction of slope at a given site and essentially determines the face of elevated

areas such as hills or mountains. Slope aspect was calculated clockwise in degrees, starting from north at 0°, completing a full cycle at 360°. On these maps, each color represents one of the primary or secondary compass directions (see Figure 1). The main benefits of aspect analysis include identifying slope direction, predicting the direction of watercourses, assessing the likely impact on groundwater, forecasting and mitigating flood risks, and determining areas with gentle slopes suitable for various development projects (Abbas et al., 2015, p. 13).

Figure (1): Slope Aspect Directions



Source: Prepared by the researchers using the Digital Elevation Model (DEM) and ARC GIS 10.3.

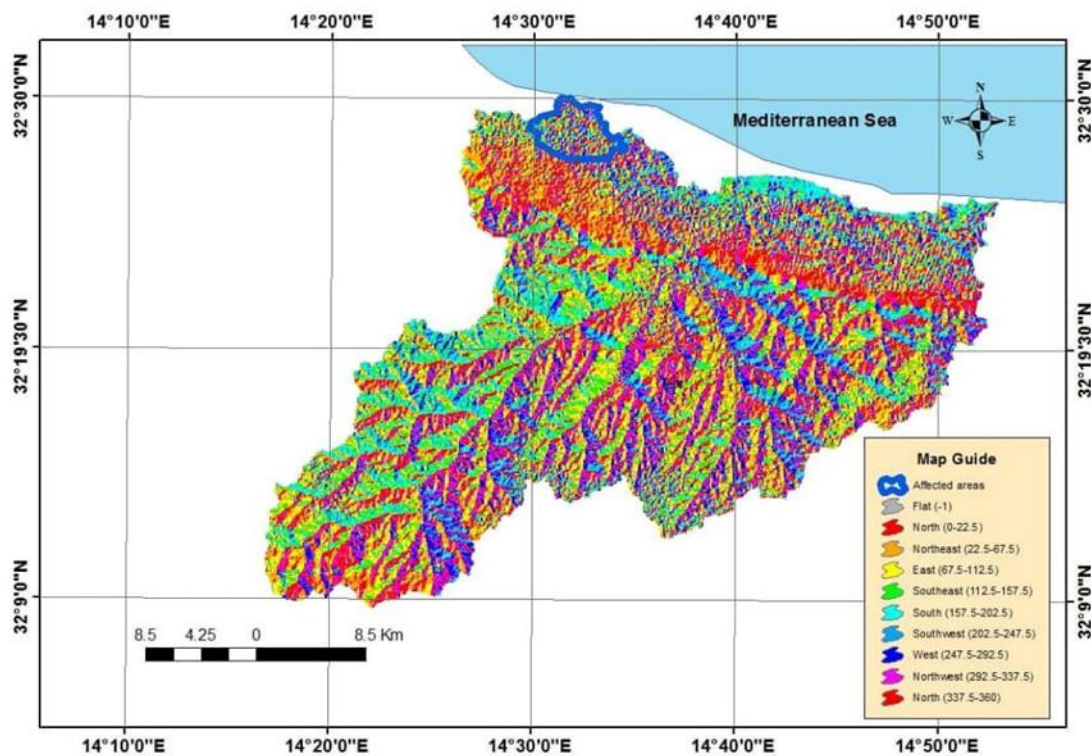
Table (3): Slope Aspect Directions of the Wadi Majer Surface According to Zink's Classification

T	Trend	grades slope direction	Areakm2	percentage %
1	Flat	3.83	0.36	0.32
2	NorthNorth	100.95	9.56	17.14
3	Northeast	179.6	17	15.32
4	East	153.32	14.58	14.44
5	Southeast	114.48	10.84	9.76
6	South	93.84	8.88	8
7	Southwest	91.94	8.7	7.8
8	West	110.12	10.42	9.4
9	Northwest	139.11	13.17	11.96
10	North	68.6	6.49	5.86
The total		1055.9	100 km ²	100%

Source: Prepared by the researchers using the Digital Elevation Model (DEM) and ARC GIS 10.3.

From Table (3) and Map (5), it is apparent that there is no dominant slope direction in the region. The north, northeast, and east orientations collectively account for 47.63% of the basin's total area, encompassing the zones experiencing high groundwater levels and representing the general direction of the Wadi Majer basin's drainage network. Next in prominence are the northwest, southeast, and west orientations (13.17%, 10.84%, and 10.42%, respectively), which represent the upper courses of water channels leading toward the main watercourse. The southwest and south orientations comprise the smallest areas (8.7%, 8.8%, and 10.42%, respectively) and generally coincide with the watershed divisions within the basin. (Abdo et al , 2025)

Map (5): Slope Aspect Directions of the Wadi Majer Surface



Source: Prepared by the researchers using the Digital Elevation Model (DEM) and ARC GIS

10.3.

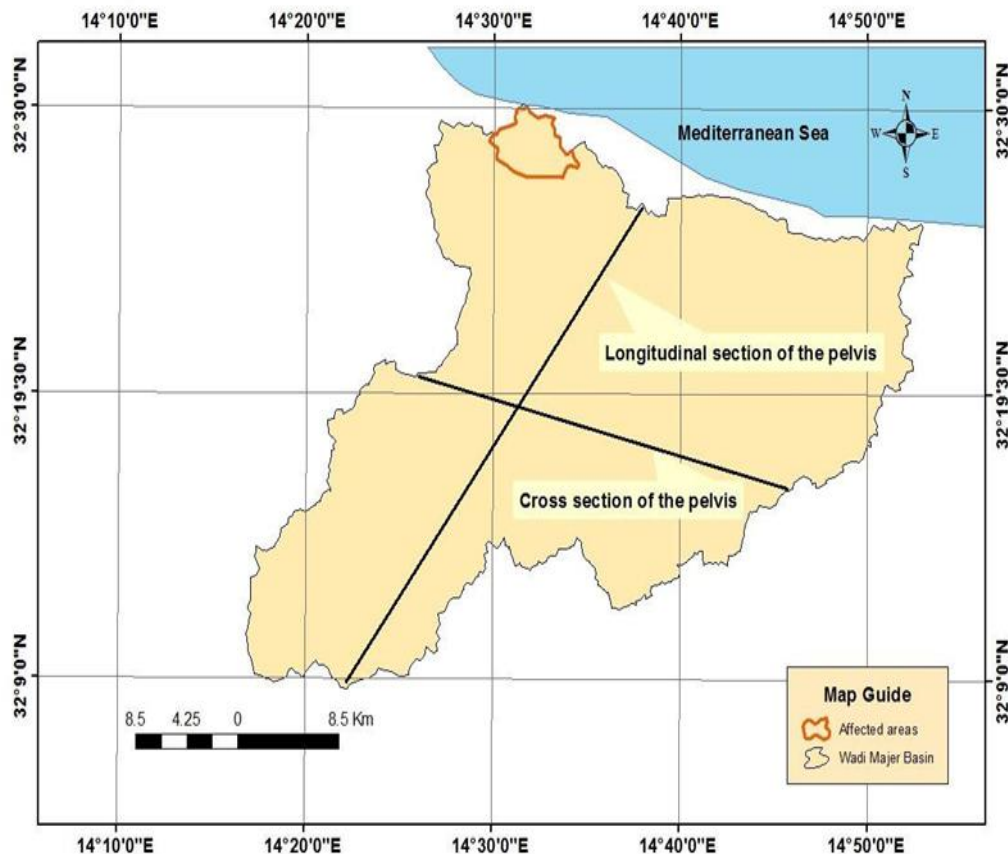
Topographical Cross-Sections of the Basin (Longitudinal and Transverse)

The study of longitudinal cross-sections is vital for illustrating the processes that shaped the watercourses, resulting in their current configuration. Interpreting the topographical features of wadis is facilitated by longitudinal profiles, while transverse profiles provide complementary information, allowing for a clearer understanding of general

topographic forms. Both types of profiles were plotted using the following spatial techniques:

- The longitudinal section of the basin extends from the source to the outlet, covering a length of 45 km and exceeding 180 meters in elevation. It is characterized by steep slopes in its southern upper reaches, gradually decreasing in inclination toward the outlet. A concave slope is noted in the northern portions, with the profile becoming more regular (see Figure 2).
- The transverse section exceeds 26 km in length and 135 meters in elevation, running from west to east across the basin. It begins with gentle inclines, then exhibits sharp slopes—particularly at distances of 6, 9, 13, and 16 km—forming a pronounced V-shape or concave profile (see Figure 3), followed by a subsequent rise.

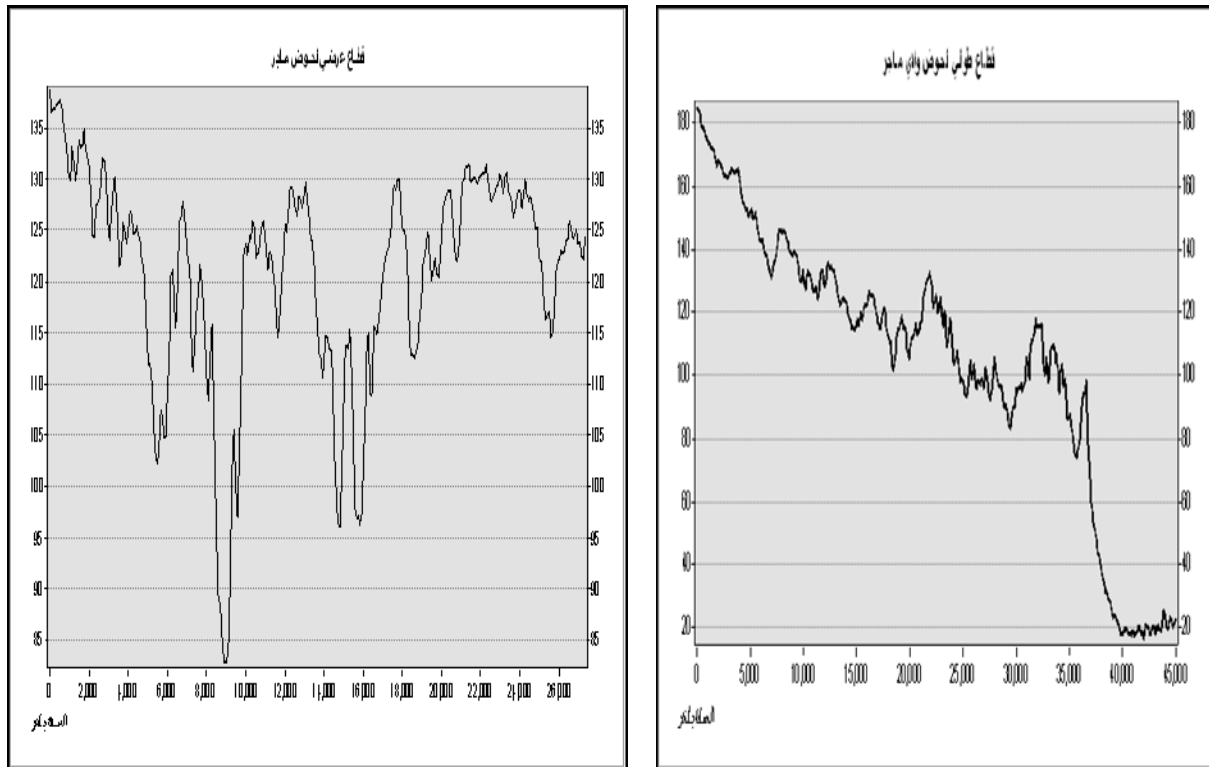
Map (6): Longitudinal and Transverse Slope Sections of the Wadi Majer Basin



Source: Prepared by the researchers using the Digital Elevation Model (DEM) and ARC GIS

10.3.

Figures (2) and (3)



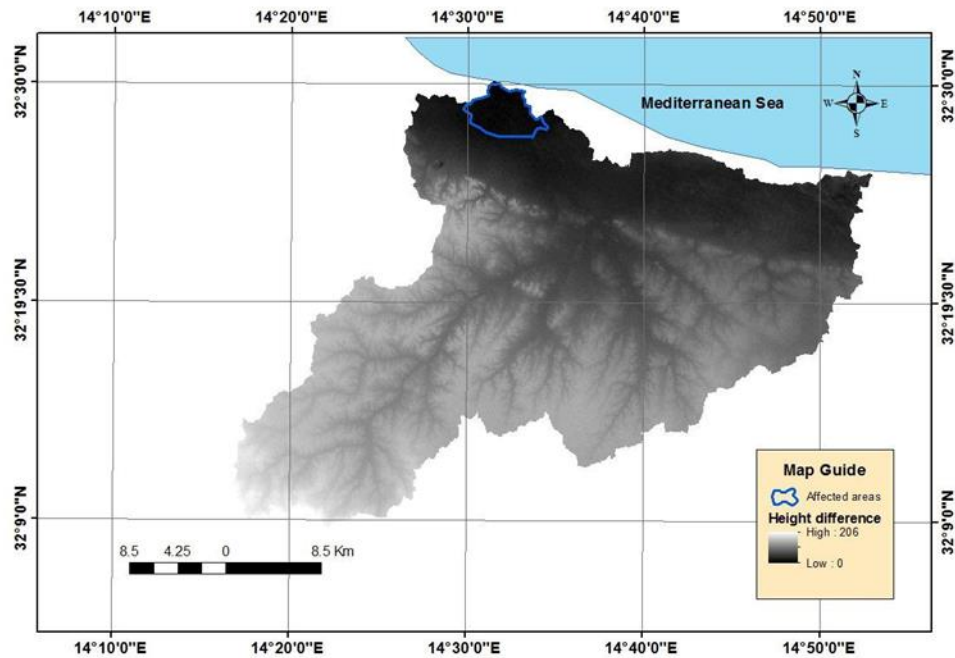
2. Analysis of the Basin's Natural Features

The study of the topographic characteristics of drainage basins is of paramount geomorphological significance, reflecting a combination of variables such as geological structure and climate. Through these variables, it is possible to determine the geomorphological stage of the basin, as well as the region's topography and the nature of its landforms, using the following metrics:

- **Maximum and Minimum Elevation:**

Elevation values vary from one basin to another, with the maximum elevation often corresponding to the basin's headwaters at the watershed divide. In the case of the Wadi Majer basin, the maximum elevation is approximately 206 meters (see Map 7), while the minimum elevation is 0 meters, generally at the basin's outlet. In the affected areas, as previously noted, elevations range from 0 to 17 meters, gradually sloping toward the sea.

Map (7): Elevation Range in the Wadi Majer Basin



Source: Prepared by the researchers based on the Digital Elevation Model (DEM) and using ARC GIS 10.3.

- **Ruggedness Ratio:**

The ruggedness ratio is an important metric for measuring basin surface roughness, as it indirectly reflects the steepness of drainage basin surfaces. Higher values indicate greater surface ruggedness and signify an early erosional geomorphological stage, while lower values suggest maturity. Ruggedness ratio is inversely proportional to basin area and discharge volume and is calculated by dividing the difference between the highest and lowest elevations by the basin's length (Al-Razouk, 2016, p. 212). In the Wadi Majer basin, the ruggedness ratio averaged 2.26 m/km, indicating low slopes and reflecting the limited elevation variation in the basin, which largely falls within low-lying areas, thereby hindering rainfall runoff near the outlet.

- **Relative Relief:**

This metric expresses the relationship between basin relief and its perimeter. Low values indicate weak rock resistance to water and active erosional processes, while high values reflect resistant rocks and subdued erosion. It is calculated as follows (Jaber, 2019, p. 526):

$$\text{Relative Relief Index} = \frac{\text{Basin Relief (m)}}{\text{Basin Perimeter (km)}}$$

The relative relief index for the basin was 1.027 m/km (see Table 4), and all values were low, attributed to the minimal vertical difference between the highest and lowest elevations in the basin. This facilitates the predominance of lateral over vertical erosion, a phenomenon enhanced by the region's sedimentary formations, which are particularly permeable in the affected zones.

Table (4): Topographical Characteristics of the Wadi Majer Basin

T	Basin name	Basin topography			Grouting ratio (m/km)	Terrain ratio (m/km)
		Height difference (m)	Minimum height (m)	Highest altitude (m)		
1	Wadi Majer	206	0	206	5.02	1.07

Source: Compiled by the researchers based on the Digital Elevation Model (DEM) and mathematical formulas for morphometric and topographical characteristics.

3. Analysis of Lineament Orientation and Length

Lineaments are geological expressions indicating surface features that may be either curved or straight. Their lengths can range from several kilometers to hundreds of kilometers. Lineaments less than 10 km in length are termed "lineaments," while those longer than 10 km are referred to as "elongations." Lineaments shorter than 2 km are classified as "short lineaments" and are typically associated with fractures and joints, commonly found in limestone, dolomite, sandstone, and clay rocks. Lineaments ranging between 2–10 km are considered "long lineaments," and they exert a direct influence on the orientation and extension of dry valleys in the region.

Lineaments and their orientations were identified within the basin boundaries, where they are widely distributed. A total of 77 lineaments were identified, classified as follows:

1. Lineaments oriented Northeast–Southwest (NE–SW):

This group includes 27 lineaments, representing 35.1% of all lineaments in the lower Wadi Majer basin. Their total length is 30 km out of a cumulative lineament length of 77.2 km, accounting for 38.9% of the total. This direction represents the most frequent orientation

(see Figure 4), which explains the prevailing direction of watercourse slopes in the basin, indicating that water flow typically starts from the southern and southwestern sectors toward the northern and northeastern regions, following the lineament paths (see Map 8).

Table (5): Directions, Frequencies, and Lengths of Lineaments in the Basin

Wadi Majer basin				ratio%
Trend geographer	repetition number	ratio%	height	
North-South	18	23.4	15.6	20.2
Northeast - South west	27	35.1	30	38.9
Northwest - southeast	22	28.6	15.8	20.5
East-West	10	13.0	15.8	20.5
the total	77	100	77.2	100

Source: Compiled by the researchers based on Landsat 8, ArcGIS 10.3 outputs, Rock Work 16, and DEM elevation data.

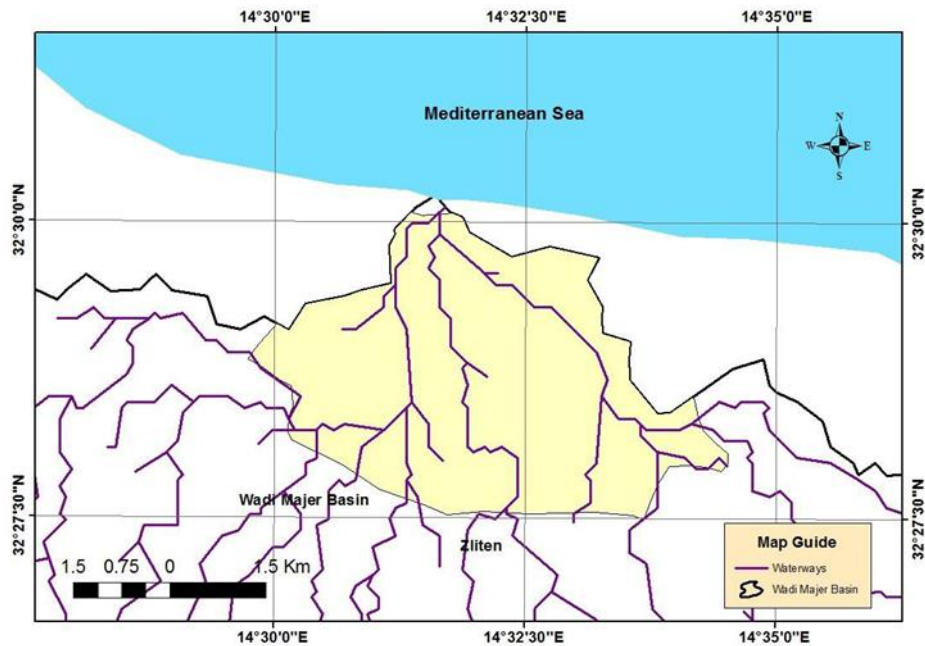
2. Lineaments oriented Northwest–Southeast (NW–SE):

There are 22 lineaments in this direction, comprising 28.6% of all lineaments. Their total length is 15.8 km, which forms 20.5% of the overall lineament length in the basin.

3. Lineaments oriented North–South (N–S):

This direction ranks third in both number and total length, with 18 lineaments (23.4% of the total) and a cumulative length of 15.6 km (20.2% of total length).

Map (8): Lineaments in the Wadi Majer Basin



Source: Prepared by the researchers based on Landsat 8 imagery and outputs from ArcGIS 10.3 and Rockwork 16.

Figure (4): Lengths of Dominant Lineament Orientations in the Basin

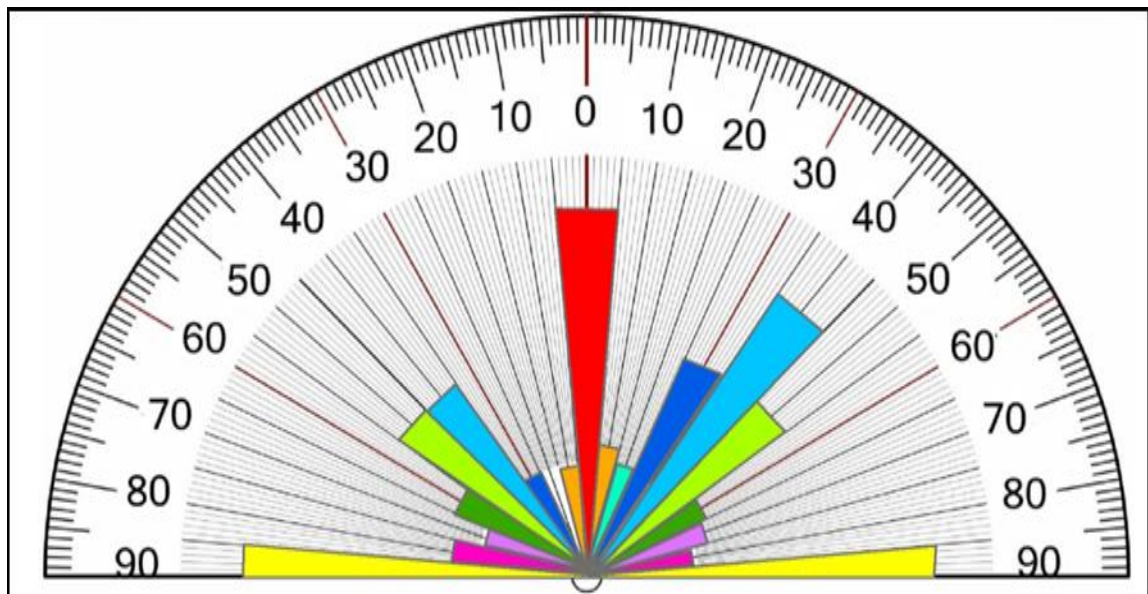
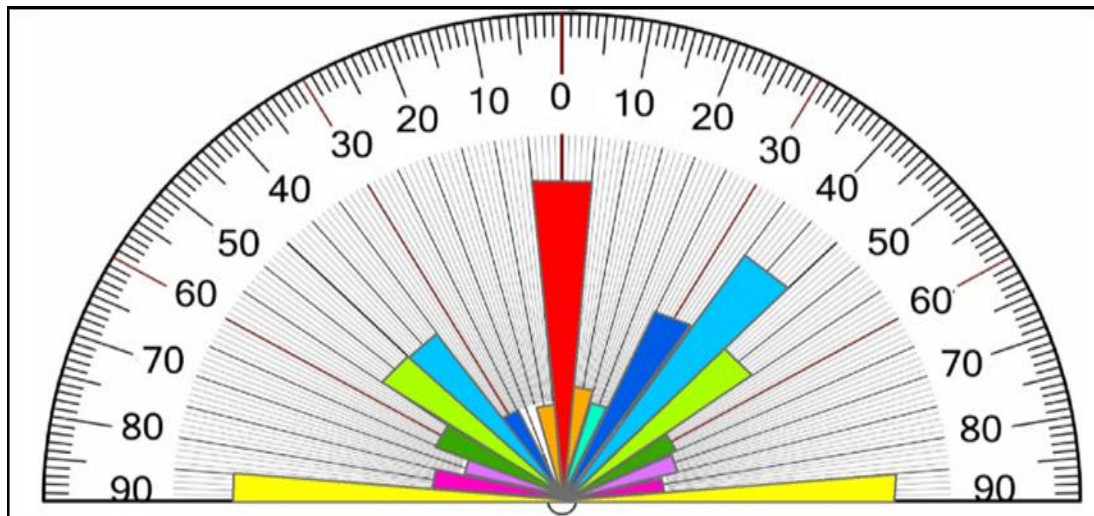


Figure (5): Number and Orientations of Basin Lineaments



Source: Prepared by the researchers using Landsat 8 imagery and ArcGIS 10.3, and Rockwork

16.

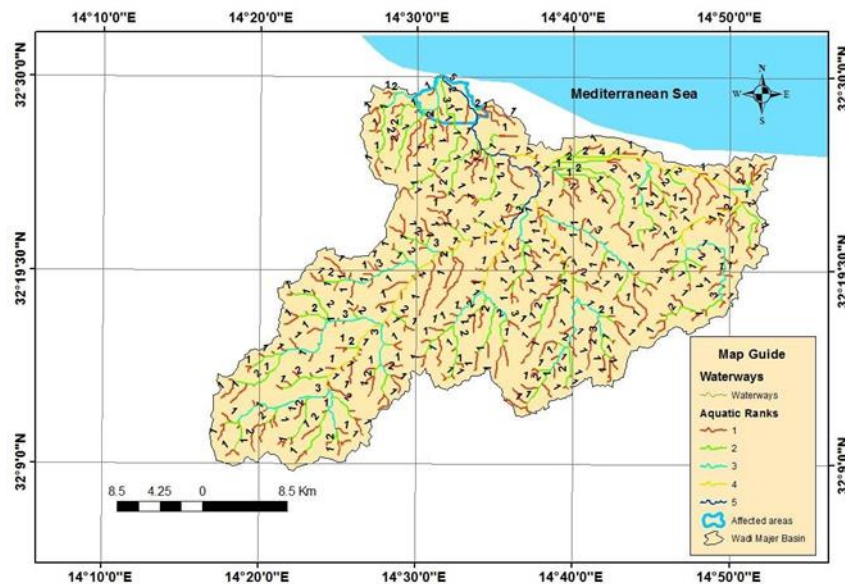
4. Lineaments oriented East–West (E–W):

This orientation has the fewest lineaments, with 10 lineaments (13% of the total). Their total length is 15.8 km, accounting for 20.5% of the total length.

4. Drainage Network

Determining the order of the drainage network plays a key role in groundwater rise, as it represents the overall pattern and hierarchy of river tributaries in the basin, which are the result of the region's lithological and structural characteristics and climatic conditions. These factors influence the overall shape of the drainage system and the activity level and geomorphological development of the basin. All these elements are crucial in determining both the general configuration of the basin's drainage network and the activity of its wadi channels (GEF. (2017)).

Analysis of drainage orders, as shown in Table (6), indicates that Wadi Majer Basin comprises five stream orders (see Map 9). The total number of watercourses within the basin is 805. An increase in the number of watercourses at any stream order enhances groundwater storage, particularly in areas experiencing groundwater upwelling.

Map (9): Stream Orders and Their Frequencies in the Wadi Majer Basin

Source: Prepared by the researcher based on the Digital Elevation Model (DEM) and using ARC GIS 10.3.

Table (6): Stream Orders and Their Frequencies in the Study Area's Basins

T	Basin name	Numbers and ranks of waterways in basins					Total sewage
		Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	
1	Wadi Majer	409	192	102	81	21	805

Source: Compiled by the researchers based on the Digital Elevation Model (DEM) and using ARC GIS 10.3.

The number of watercourses varied across different stream orders. In the Wadi Majer basin, first-order streams numbered 409, accounting for 50.8% of the total number of streams across all orders. Second-order streams totaled 192, representing 23.8%; third-order streams numbered 102, comprising 12.6%; fourth-order streams accounted for 81, or 10%; and fifth-order streams had the lowest count, with 21 streams, making up 2.6% of the total.

Climatic Characteristics

Various climatic elements, particularly rainfall, have a direct impact on groundwater upwelling, as observed in the study area. Examining the climate—especially precipitation—is essential for understanding the prevailing hydrological conditions. Rainfall also influences the formation, type, and development of watercourses, soil evolution, and the density of natural vegetation. The climate classification of the study area was determined

using climate data and the Thornthwaite formula (*), which indicates that the area has a semi-arid climate (Baqas, 2015, p. 291), as shown in Map (10), based on the aridity index value of 16.

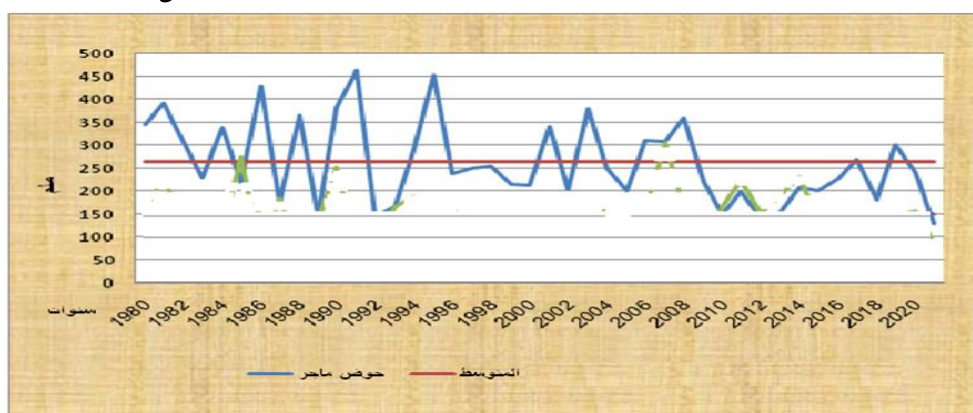
The study area receives rainfall under the Mediterranean climate regime, with precipitation beginning in autumn. According to Table (7) and Figure (6), the rainy season starts in October and extends until March, peaking in December with rainfall reaching 60.5 mm in the Wadi Majer basin. The average annual rainfall in the study area is 267.1 mm, including the affected zones, which have repeatedly experienced severe storms in recent years, resulting in a significant rise in groundwater levels—by more than 30 cm in wells monitored by the researcher during 2020–2024.

Table (7): Monthly and Seasonal Average Rainfall Totals in the Study Area (1980–2023)

Season	Winter			Spring			Summer			Autumn		
Month	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Monthly Average	60.9	51.8	27.8	21.5	8.7	3.2	1.3	0.0	1.4	11.6	30.5	48.4
Seasonal Average	5 0 4 1			33.4			2.7			90.5		
Annual Average	2		6	7								

Source: Compiled by the researcher based on data from the Meteorological Authority, Tripoli, Climate Department, 2021, and NASA Langley Research Center.

Figure (6): Annual Rainfall Totals in the Area, 1980–2023.



Source: Compiled by the researcher, Meteorological Authority, Tripoli, Climate Department, 2023.

Natural Factors in the Basin and Their Relationship to Groundwater Rise

Natural factors have a clear and significant influence on the probability and variability of groundwater upwelling. These factors, which include the area's geology, lineament structures, elevation, and soil properties, each have distinct effects. The main natural factors likely influencing groundwater levels in the study area are:

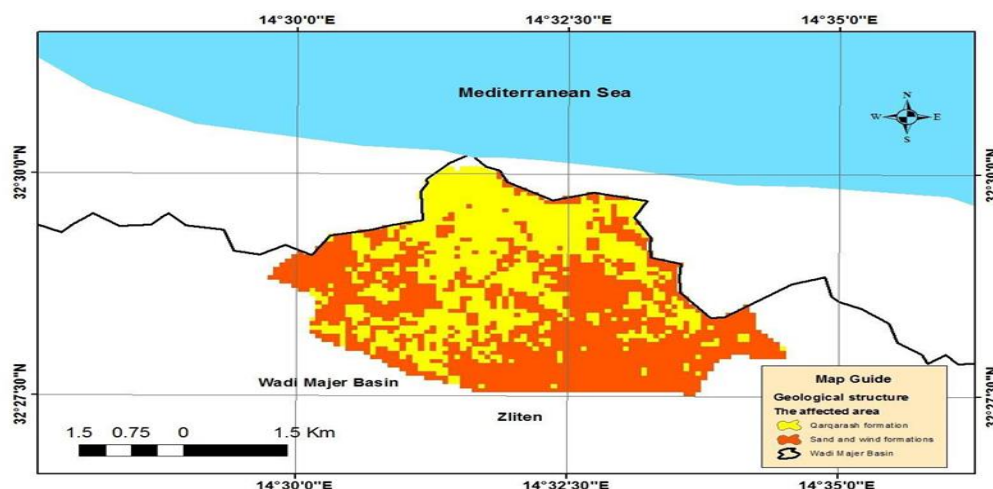
1. Geological Structure

Geological structure plays a crucial role in directly affecting groundwater rise in the affected area by determining the locations, movement, and directions of groundwater reservoirs. The type of rock affects water permeability, and the arrangement of geological layers determines the thickness of the aquifer, while the dip and orientation of rock layers control groundwater movement and flow velocity.

The affected areas lie within two distinct but physically similar geological formations (see Map 11):

- **Qarqarish Formation:** Composed of marine-origin sandy deposits appearing near the coast, characterized by high cohesion due to silt and sandy clay content. This formation allows significant rainfall infiltration, causing water to accumulate near the surface, supported by an underlying impermeable clay layer—thus clearly contributing to groundwater rise. Historical records confirm that fresh water was once close to the surface here in the mid-20th century.
- **Aqueous and Aeolian Deposits:** These result from wind and water erosion and form layered deposits along the wadi channels and at their mouths as alluvial fans and sand dunes (98% of which have been removed). Formerly, these covered most of the affected area, are highly porous, and played a major role in surface water absorption and groundwater retention.

Map (11): Geology of the Affected Area

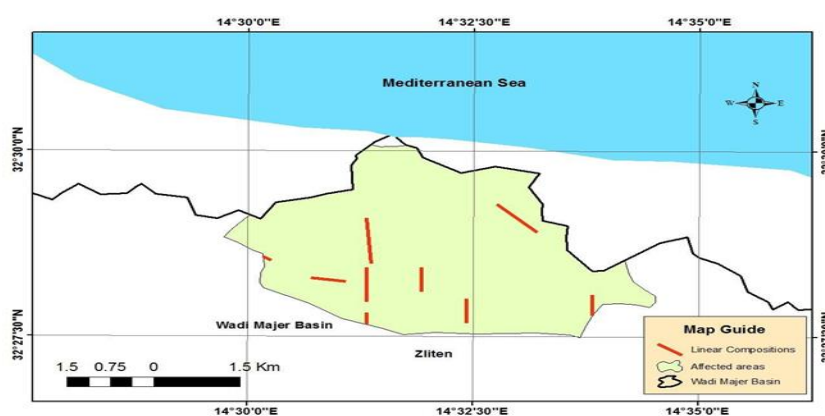


Source: Compiled by the researchers using the Geological Map of Libya, Khoms Sheet No. Sh 33-14, Industrial Research Center, 1st Ed., 1975, and ArcGIS.

2. Lineament Structures

The affected area contains numerous lineaments, which generally do not appear at the surface but occur in subsurface layers, ranging in length from 0.16 to 4 km. These faults and fractures provide pathways for water to flow into deeper layers and enhance rock permeability, even in otherwise consolidated rocks such as limestone. These features directly affect groundwater levels, as water infiltrates through the fractures in sedimentary formations, filling the aquifer with both rainwater and surface water, eventually returning to the surface as water bodies that can damage infrastructure, farms, and settlements (see Figure 1).

Map (12): Lineaments in the Affected Areas



Source: Compiled by the researchers using Landsat 8 imagery, ArcGIS 10.3, and RockWork

Figure (1): Water Bodies

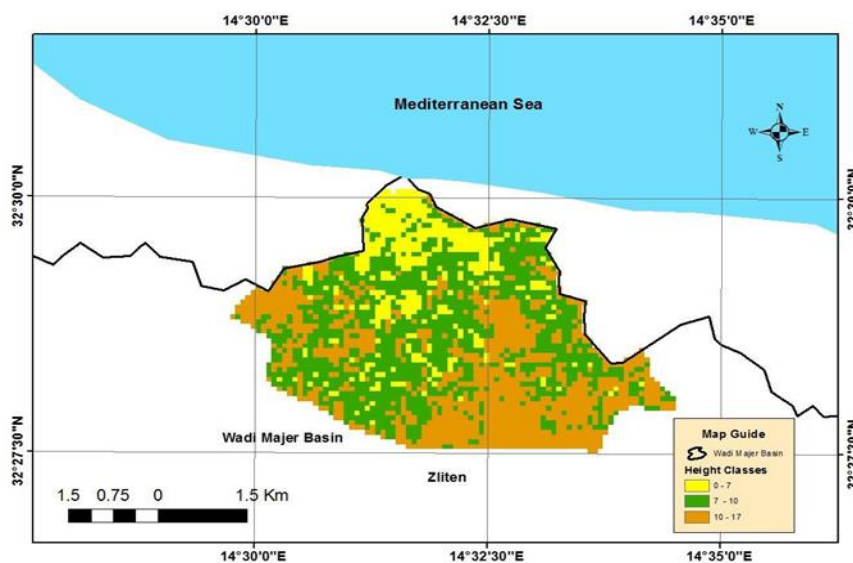


Source: Field Study, 5-3-2023.

3. Elevation Characteristics

The study area is characterized by a generally flat surface, which favors the infiltration of maximum possible rainfall and surface water, unlike steep or complex terrain where such infiltration is limited. The prevailing flatness facilitates all life activities and land uses. According to Map (13), the surface is mostly flat with some elevation at the edges and central parts. Elevation in the study area ranges from 0–17 meters above sea level, with the 0–7 m category covering 25% and the 7–10 m category 49% of the total area.

Map (13): Elevation Categories in the Area



Source: Compiled by the researchers using the Digital Elevation Model (DEM) and ArcGIS

The area also contains many depressions formed by the removal of sand dunes once used in construction and originally created by ancient deposition processes (see Figure 2). These exceed 10 meters in height and several hundred meters in width, previously covering over 80% of the affected area, where they contributed to rainwater absorption and capillarity. The removal of these dunes is linked to the observed groundwater rise.

Figure (2): Sand Dune Removal from the Area



Source: Archival photograph.

4. Slope Characteristics

Slope plays a significant role in the study area, as it governs both the horizontal movement of surface water and the percolation and infiltration of water within the soil. (

Sadek et al 2021), The area is characterized by gentle slopes (see Table 8 and Map 14), ranging between 0 and 2.6 degrees. The lower the slope, the slower the rate of surface runoff and the higher the potential for infiltration and percolation, which is evident in the study area. Additionally, the slope generally trends toward the discharge point. To better understand the distribution of slope classes, a slope map was generated using the Digital Elevation Model (DEM), with slope classes determined according to Zing A.W.'s classification, as follows:

- **First Slope Class:**

Slopes range from 0 to 0.62 degrees and cover an area of 17.22 km², accounting for 81.61% of the total study area. This is the most widespread class in the region. Due to the minimal inclination, surfaces within this class favor water infiltration and serve as receiving areas for water flowing from higher elevations.

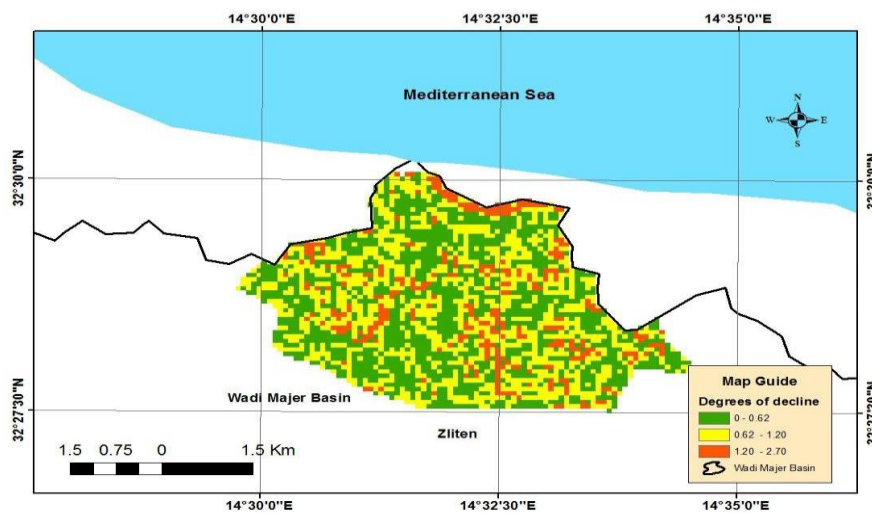
- **Second Slope Class:**

Slopes in this category range from 0.62 to 1.19 degrees, covering an area of 3.69 km², or 17.48% of the total study area.

- **Third Slope Class:**

Slopes in this category range from 1.19 to 2.68 degrees, occupying an area of 0.19 km², representing 0.9% of the total study area.

Map (14) of the slope degrees in the area



Source/The researchers Work relied on the digital elevation model (DEM) and used the ARC GIS 10.3 program.

Table (8): Slope Classes in the Area

T	Grade gradient	Study Area km2	%
1	0-0.62	17.22	81.61
2	0.62-1.19	3.69	17.48
3	1.19-2.68	0.19	0.9
		21.1	100%

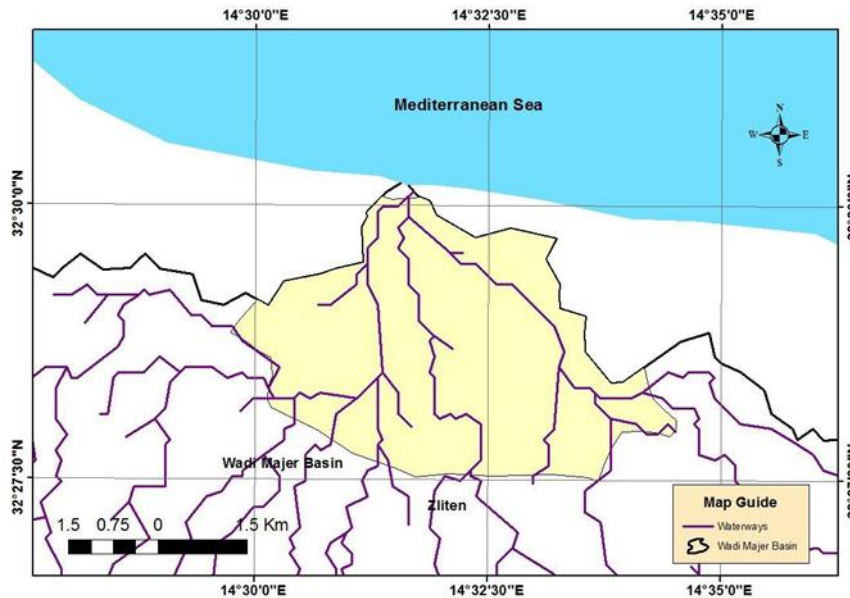
Source: Compiled by the researchers using DEM and ArcGIS 10.3.

5. Watercourses

The study area contains several watercourses, though their features are often indistinct. The region also serves as a passage for the main Wadi Majer channel and some of its tributaries(15- (Anwar, et al .2024) (see Maps 15–16). All these factors have

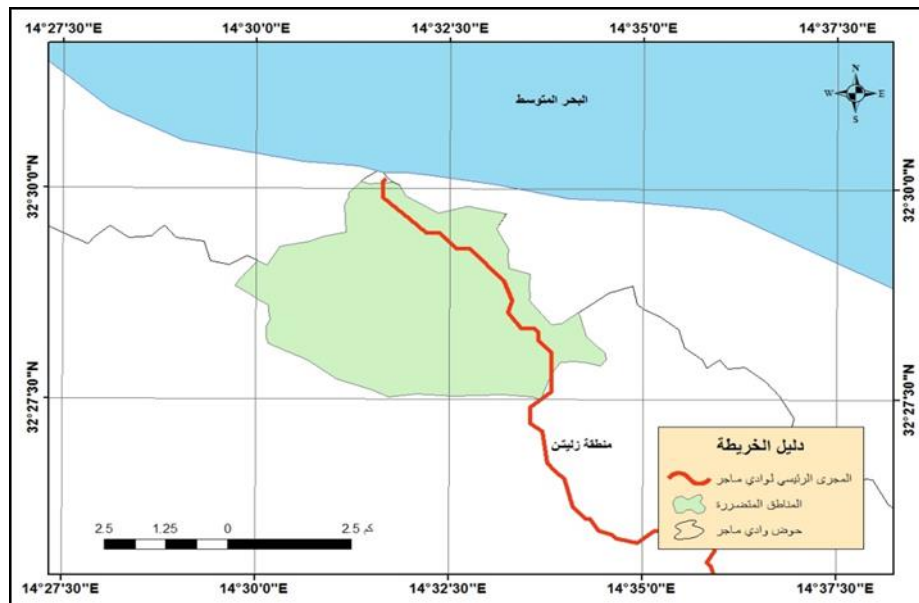
contributed to the groundwater rise in the area, where there are 29 watercourses of stream orders 1, 2, 3, and 5, with a total length of 28.5 km.

Map (15): Watercourses in the Area



Source: Compiled by the researchers using DEM and ArcGIS 10.3.

Map (16): Main Wadi Channel in the Area



Source: Compiled by the researchers using DEM and ArcGIS 10.3.

6. Soil

Soil is of special importance when studying groundwater. Its texture and structure are key factors in regulating water percolation to depth. The area's soils are mostly sandy and dry (see Map 17). According to analysis (Table 9), A

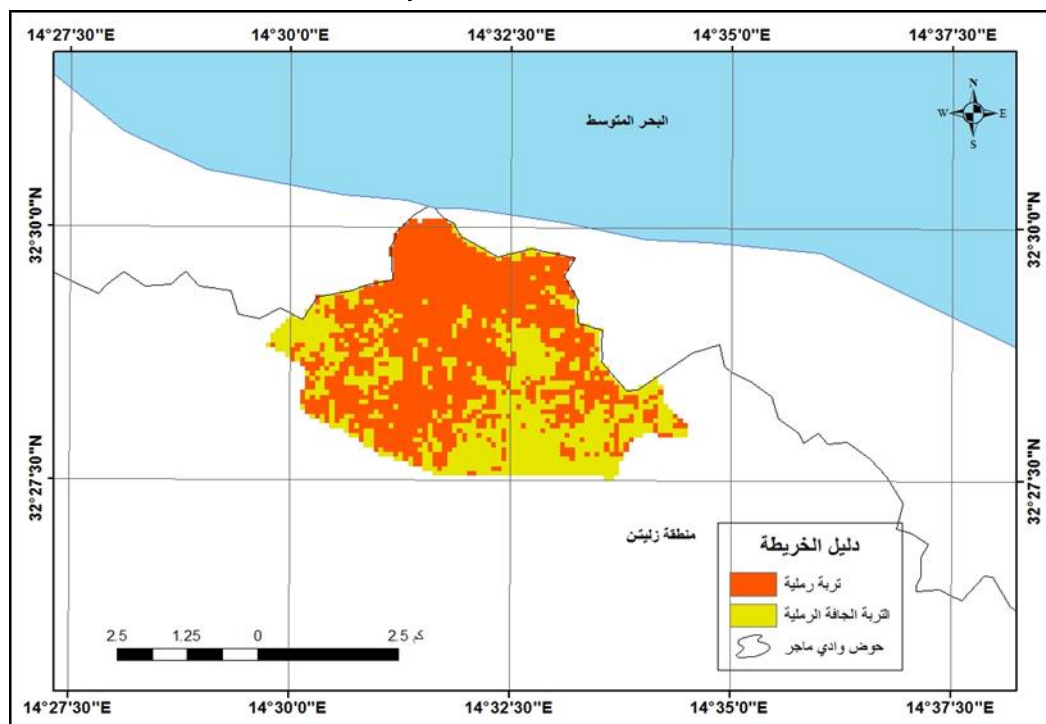
single soil sample was used as a representative model because the soil in the study area is of a uniform type. the soil texture in the study area is predominantly sandy to sandy-loam, accounting for 87.45% of the sample, due to the presence of sandy rocks and the prevalence of aeolian transport. Silt forms 10.3% and clay 2.25%.

Table (9): Soil Texture Characteristics in the Area

Sample No.	Location	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	Soil Texture
1	Al-Mantriha	0–30	87.45	10.3	2.25	Sandy

Source: Adapted from Nadia Faraj Al-Eisawi, "Survey and Classification of Soils in Zliten Using GIS," unpublished MA thesis, Faculty of Arts, Damietta University, 2018, p. 84.

Map (17): Soils in the Area



Source: Compiled by the researchers based on the field study and ArcGIS 10.3.

Conclusions

The main findings of this study can be summarized as follows:

1. GIS-RS technologies are among the most effective tools for analyzing natural factors, including slope, elevation, and lineament structures.
2. Geographic spatial technologies provide accurate data and information that are not available through traditional study methods.

3. The affected area is generally characterized by a low degree of ruggedness.
4. The regions experiencing groundwater rise constitute a low-lying basin within the Wadi Majer basin, which impedes the drainage of both groundwater and surface water.
5. There may be groundwater movement toward the areas exhibiting elevated groundwater levels.
6. More than 25% of the area does not exceed 7 meters in elevation, and 50% of the area does not exceed 10 meters.
7. The software programs employed have proven effective in compiling extensive information about the basin and the characteristics of the affected areas.
8. Basin slopes originate from the southern and southwestern sections, following the general gradient toward the affected areas, thereby contributing to the rise in groundwater levels.
9. Analysis of the slope map shows that most of the affected area is nearly level (0–0.62 degrees), which has facilitated the rise in groundwater.
10. The longitudinal profile of the basin indicates that slopes are directed toward the affected areas.
11. Geological natural factors have contributed to the rise in groundwater levels by preventing water from infiltrating to deeper layers.
12. GIS-RS techniques have revealed variations in the spacing of contour lines, resulting from differences in the subsurface structure.
13. There are 29 lineaments in the area, which have facilitated water infiltration.
14. The number of first-order streams in the area is 12, representing 41.3% of the total number of streams across all orders, most of which terminate in the regions experiencing groundwater upwelling; in addition, the main channel is 6 km long.

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In the Name of Allah, the Most Gracious, the Most Merciful

Editorial

Dear Researchers and Readers,

It is our pleasure to present Issue Three of the 2026 volume of the University of Anbar Journal of Humanities, a quarterly, peer-reviewed academic journal published by the University of Anbar. The journal is dedicated to the publication of rigorous scholarly research and studies across the diverse disciplines encompassed by the humanities. This issue features fourteen research articles contributed by scholars from Iraq and abroad and representing a range of universities and academic institutions. This diversity reflects the journal's commitment to enriching human knowledge and broadening the horizons of scholarly research.

The contributions presented in this issue represent the outcome of considerable scholarly effort and intellectual engagement on the part of the contributing researchers, complemented by the dedicated work of the Editorial Board and the expert reviewers. Through their academic expertise and careful evaluation of the submitted manuscripts in accordance with established scholarly standards, they have contributed substantially to ensuring the quality and academic integrity of the published research and to presenting this issue in a form that reflects the journal's scholarly standing and mission.

The Editorial Board takes great pride in the scholarly contributions featured in this issue and extends its sincere appreciation to all researchers and reviewers, as well as to everyone who contributed to its preparation and publication. We pray that this body of scholarly work will prove beneficial to researchers, postgraduate students, and all those interested in the humanities, and that it will constitute a meaningful contribution to the academic and scholarly literature.

The continued scholarly contributions of researchers, the sustained efforts of the Editor-in-Chief and members of the Editorial Board, together with the ongoing support of the Presidency of the University of Anbar and the Deanship of the College of Education for Humanities, constitute essential pillars for advancing the journal's development and achieving its academic and scholarly objectives.

As part of our commitment to strengthening the journal's position within the academic community, the Editorial Board is continuously working to develop its publication standards and update its editorial, peer-review, and publication procedures in accordance with recognized standards of rigorous scholarly publishing. These efforts are intended to enhance the quality of the research published in the journal and to further improve future issues. Our aspiration is to advance the journal's scholarly standing, strengthen its academic visibility, and enhance its prospects for inclusion in international indexing and abstracting databases and other recognized platforms for scholarly publishing, thereby consolidating its presence within the Arab and international academic communities.

We firmly believe that peer-reviewed academic journals constitute one of the fundamental pillars of the research ecosystem. They play a vital role in generating and disseminating knowledge, making scholarly findings accessible to researchers and interested readers, and fostering academic communication and collaboration among universities and research institutions in Iraq and beyond. Accordingly, the journal seeks to serve as an active scholarly platform that keeps pace with contemporary developments in the humanities, promotes rigorous



academic inquiry, and provides opportunities for high-quality research addressing significant human, intellectual, social, and cultural issues.

Finally, we extend our sincere thanks and appreciation to all researchers who contributed to this issue, to the reviewers and members of the Editorial Board, and to the University of Anbar and the Deanship of the College of Education for Humanities for their continued support of the journal's academic mission. We hope that this issue will receive the attention it deserves from researchers and readers alike and will continue to contribute meaningfully to the advancement of knowledge and scholarly research.

Prof. Dr. Fuaad Mohammed Freh
Editor in Chief

Publication Guidelines of the *Journal of University of Anbar for Humanities (JUAH)*

General Procedures and Research Specifications

- *Journal of University of Anbar for Humanities (JUAH)* is a peer-reviewed scientific periodical that publishes scholarly research in the following fields of humanities: History, Geography, Educational Sciences, and Psychology. The journal is issued quarterly (four issues per year).
- Manuscripts must be submitted electronically via the journal's website: <https://juah.uoanbar.edu.iq>. Submissions must follow these specifications: A4 paper size, double-spaced (including footnotes, references, tables, and appendices), with wide margins of at least 2.5 cm on all sides.
- Authors must provide a cover letter confirming that the manuscript, or any similar version, has not been previously published or submitted elsewhere inside or outside Iraq, until the review process is completed.
- The maximum length of a manuscript is 25 pages.
- Manuscripts must be written in correct Arabic or English, typed on a computer in *Simplified Arabic* font, size 14, with clear distinction between main and sub-headings.
- Footnotes and references should follow *APA* documentation style, in font size 14. References must be listed sequentially as cited in the text and organized alphabetically in accordance with academic methodology, in both Arabic and English.
- All publication rights belong to the journal.
- The views expressed in published papers are solely those of the authors and do not necessarily reflect the opinion of the journal.

Author Information and Abstracts

- Authors are required to provide their details and research information in both Arabic and English, including: the title of the paper, names and affiliations of all authors, mobile phone number, email address, and two abstracts (Arabic and English). Each abstract must be at least 250 words and include keywords, research objectives, methodology, and the main findings.

Research Tools, Tables, and Figures

- If the research involves a questionnaire or other data collection tools, a complete copy must be provided unless it is already included within the manuscript or appendices.
- Tables and figures should not exceed the width of an A4 page and must be embedded within the text.
- Figures should appear immediately after the paragraph in which they are referenced, with the caption placed below the figure.
- Tables should appear immediately after the paragraph in which they are referenced, with the caption placed above the table.

Peer Review Process

- All submitted manuscripts are subject to preliminary screening by the Editorial Board to determine their eligibility for peer review. The Board reserves the right to decline a submission without providing reasons.

- All research review processes follow the double-blind review system to ensure the rigor of the research and to avoid conflicts of interest.
- All manuscripts undergo rigorous scientific evaluation to ensure academic quality. Authors may be required to revise their papers if necessary.

Open Access

- All articles are made available on the journal's website and the Iraqi Academic Journals platform under an open access policy.

Publication Fees

- Authors are required to pay publication fees as follows:
 - 150,000 IQD (one hundred fifty thousand Iraqi dinars) for manuscripts written in Arabic.
 - 75,000 IQD (seventy-five thousand Iraqi dinars) for manuscripts written in English.
 - For manuscripts exceeding 25 pages, an additional fee of 5,000 IQD (five thousand Iraqi dinars) will be charged for each extra page.
 - Manuscripts submitted by researchers from outside Iraq are published free of charge.

Correspondence

- All correspondence should be addressed to:
Republic of Iraq – University of Anbar – College of Education for Humanities— *Journal of University of Anbar for Humanities (JUAH)*.
- Website: <https://juah.uoanbar.edu.iq>
- Email: juah@uoanbar.edu.iq

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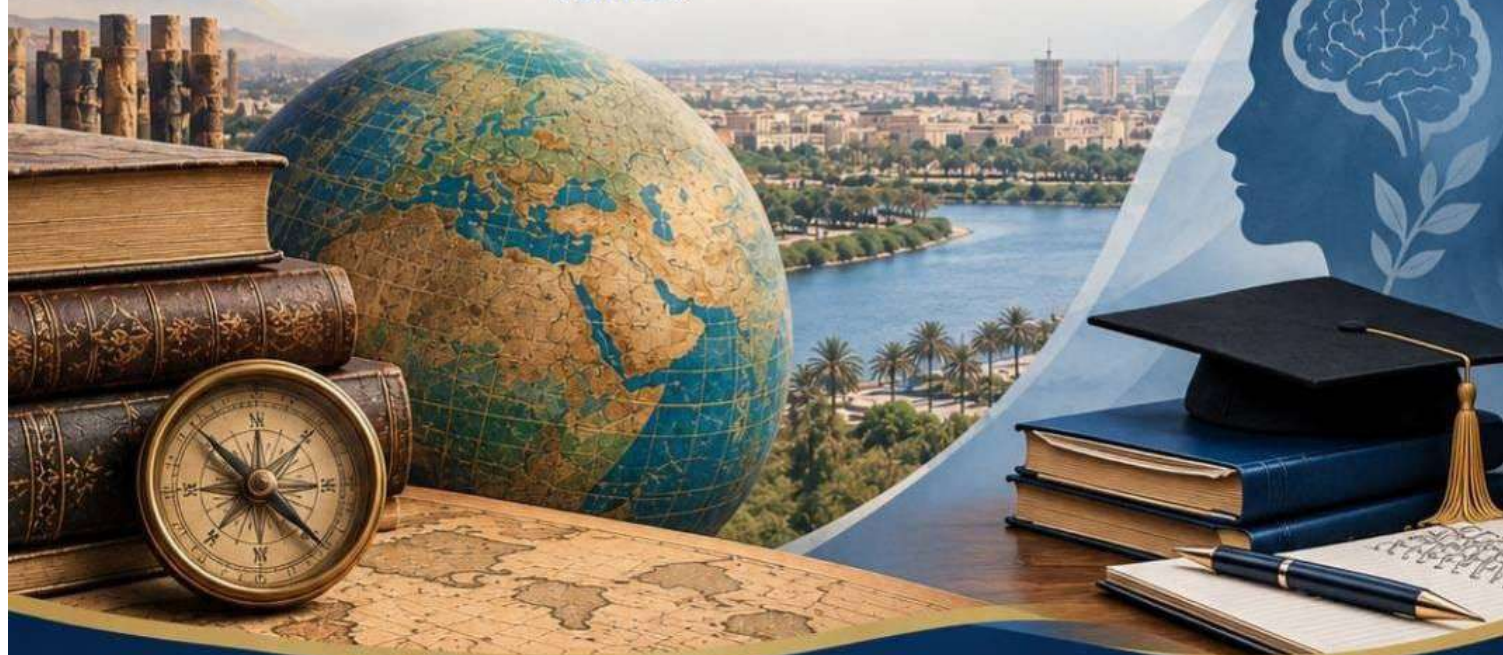
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